QE
51
C13+

QE
51
C13+

Cornell University Library
QE 51.C13
Catalogue of the Geological Museum, Cair
3 1924 004 004 184
engr

CORNELL
UNIVERSITY
LIBRARY

25

SURVEY DEPARTMENT.

CATALOGUE

OF THE

GEOLOGICAL MUSEUM

CAIRO.

COMPILED BY

W. F. HUME, D.Sc., A.R.S.M., F.G.S.

CAIRO:
NATIONAL PRINTING DEPARTMENT
1905

Cornell University Library

The original of this book is in
the Cornell University Library.

There are no known copyright restrictions in
the United States on the use of the text.

http://www.archive.org/details/cu31924004004184

SURVEY DEPARTMENT.

CATALOGUE

OF THE

GEOLOGICAL MUSEUM

CAIRO.

COMPILED BY

W. F. HUME, D.Sc., A.R.S.M., F.G.S.

CAIRO:
NATIONAL PRINTING DEPARTMENT
1905

Eu

QE
51
C13+

47716 B

GEOLOGICAL MUSEUM

CAIRO.

The *Geological Museum* of Cairo, which was opened to public inspection on December 1st, 1904, has been founded with the object of preserving permanent records of the geological products of Egypt in relation to their, (1) Economic and Practical Use, (2) The Nature of the Minerals and Rocks, (3) The past Life-Record of Egypt.

Bearing this classification in mind, the rooms devoted respectively to these aims are as follows:

1. *East Room*, Ground Floor. Economic Gallery.
2. *East Room*, Upper Floor. Stratigraphical Gallery.
3. *Central Room*, Upper Floor. Palæontological Gallery.
4. *West Room*, Upper Floor. Petrographical Gallery.

The West Room, Ground Floor, is at present used as a storage and work-room, a Curator's Room and Laboratory completing the Museum.

Room 1 is mainly devoted to the building stones, records of underground structure obtained in boring operations, clays used in pottery, salts of economic value and rocks associated with minerals of value.

Room 2 contains a large collection of the Invertebrate fossils arranged according to relative age.

Room 3 should be specially visited, as it contains unique Vertebrate remains from the Fayum.

Room 4 contains the mineral and rock collections.

Hours of opening.—The Museum is open from 1st October to 30th April, 8. 30 a.m. to 4 p.m. 1st May to 30th September, 8. 0 a.m. to 2. 0 p.m., except Fridays and Government holidays.

In the Central Hall of the Ground Floor is the sale-room for the Survey Department Catalogues and maps, including the memoirs of the Geological Survey, which are as follows:

	Price Mills.
Geological and Topographical Report on Kharga Oasis, 1899 (illustrated).	250
,, ,, ,, Farafra Oasis, 1899	150
,, ,, ,, Dakhla Oasis, 1900	200
,, ,, ,, Baharia Oasis, 1903	200
Report on Jebel Garra and Oasis of Kurkur, 1902 (illustrated)	150
Report on Cretaceous region of Abu Roash, 1902 ,, ...	200
Topography and Geology of Eastern Desert, 1903 ,, ...	400
Note on Arsinoitherium Zitteli, 1902 ,, ...	050
Note on some new fossil Mammals, 1902 ,, ...	100
Preliminary notice of the large Tortoise from Fayum, 1903...	050
Preliminary investigation of Soil and Water of Fayum Province, 1902 ...	075
Report on Disintegration of Building Stones in Egypt, 1902	075
Report on Soil and Water of Wadi Tumilat, 1903...	100
The Fayum: its Geology and Topography, 1905	300
The Phosphate Deposits of Egypt, 1905	—

The remaining space in the Central Hall is devoted to an exhibit of fossil silicified trees from the Fayum, and in the table-case is an interesting series of flint implements from the Fayum and Nile Valley.

CAIRO GEOLOGICAL MUSEUM

I.—ECONOMIC GEOLOGY.

East Room, Ground Floor.

This room is devoted to the exhibition of:—

1.—Rocks used for building and ornamental purposes.

2.—The records obtained from borings illustrating the underground structure of the country.

3.—Other economic products of importance in Egypt.

The stands are marked by letters, and the following are the more salient features of interest.

STAND **A.** Nos. 1 to 3 are the Basalts of Abu Zabel, north of Cairo, from which locality all the road-metal for Cairo is obtained. Before the discovery of this rock, basalt was imported from Naples for this purpose.

Nos. 4 and 5 are the sandstones of Jebel Ahmar, the red hill to the north-east of Cairo. ~~As these rocks are rare in the neighbourhood of the Capital, their occurrence is of some importance.~~ "The compact sandstone from the centre of the hill is used for millstones, while the ~~cracked~~ broken rock on the sides is screened and used for road-metal," [illegible]

The Building Stones quarried between Cairo and Helwan are exhibited in Cases **A** to **E**, and on the walls are hung tables showing number of quarry, position of bed, weight per cubic metre, and the other essential details for each specimen.

Stand **A.** The upper white Dowaiaqa limestone is almost exclusively burnt for lime, the lower 9 metres being used for building purposes. The quarries, which are situated on both sides of the road from the tombs of the Caliphs to Ain Musa, have supplied the main building material for the suburbs of Abbasia, Mataria and Zeitun, the stone being also sent to Tanta, Zagazig, Mehallet and Mansura.

STAND **B.** The limestones here exhibited are quarried in the cliff behind the Citadel, and though not of very durable character, are mainly used for buildings in Cairo, being easily extracted and dressed.

STAND **C.** The hardest limestone in the neighbourhood of Cairo is obtained from the low plateau of Atar El Nebi which terminates abruptly south-east of St. George's station (Helwan Railway), the locality being easily recognized by the windmills which crown it. The stone quarried here is of a durable nature.

STAND **D.** Of chief interest here is the Hashmi Sandstone, this being with Gebel Ahmar the only occurrence of sandstone near Cairo of economic importance. The limestone worked by the Prisons Department at Tura is also of good quality.

STAND **E.** The soft limestones of Massara and Helwan are used for ornamental work and the stone-flooring adopted in Cairo. They also form the building-stone of Helwan, but the dry climate alone renders their use possible for building constructions.

STAND **F.** This exhibit includes some of the most interesting rocks of Upper Egypt. Among these may be specially noted.

1. The series of granites, etc., from Aswan used in the construction of the Aswan Barrage. No. 362 is of special interest as being the "monumental granite" of the Ancient Egyptians.

2. Imperial Porphyry (Porfido rosso antico) quarried by the early Roman Emperors (Claudius, Nero, Trajan). Only known from Jebel Dokhan and neighbourhood, in the desert 110 kilometres north-east of Qena. This characteristic Egyptian rock was used as an ornamental stone in all the ancient cities of Italy and the Byzantine Empire.

3. No. 332 is the so-called Egyptian Alabaster, worked by the Ancient Egyptians, and used for the pillars of the citadel mosque by Mehemet Ali Pasha.

4. Ornamental Breccia (the Broccatelli of the Italians, Nos. 383 and 384) also used by the Ancient Egyptians for statues. There is a fine statue of the Monkey God in the British Museum made entirely of this material.

5. Some of the limestones in Upper Egypt are of very good quality, that of Isawia (Nos 345 to 348) having been used in the construction of the Assiut Barrage.

6. The Sandstones north of Aswan (Nos. 348 to 354) are used locally for building, bridges, etc. This stone is being extensively quarried at present for the Kom Ombo Land Company.

7. GYPSUM (No. 369) is an important local product, over 150 camels being engaged daily in transporting this material from a hill south-east of Helwan to the Nile Valley. It is widely distributed in the Moqattam Hills east of the Cairo-Helwan line, working concessions having been granted for the whole of this district. It is also

worked at Wadi El Gibs, south-west of Alexandria, and concessions have been granted for working in the Fayum and north of Ismailia.

STAND **G.** The sandstones of Upper Egypt are constantly being quarried for railway bridges and for the constructions of the Kom Ombo Co., those most commonly used being the coloured sandstones near Khattara, north of Aswan (Nos. 411 to 413). Owing to their suitability for carving and painting, the Ancient Egyptians preferred the softer sandstones (No. 443) of Silsila, where they had quarries of great extent, and Jebel Seraj (No. 442).

Nos. 405 to 407 are the materials used by the Massara Cement Co. for the production of their cement. The limestones and clay are both obtained in the immediate neighbourhood of Massara.

Nos. 447 to 449 are the Nitrate Shales of Upper Egypt, which have given rise to an active local industry, the shales which are connected with certain definite strata (the Esna Shales), being dug by the natives and spread on the fields without further preparation. Their value as a manure is unfortunately seriously diminished by the presence of injurious salts, but the natives evidently believe in their efficacy, as in four days of April 475 camels and 298 donkeys were counted engaged in this transport between Esna and Mahamid.

Nos. 444 to 446 are the deposits from the Natron valley near Mahamid, these being of interest as being very similar to those of the well-known valley of Wadi Natrun.

STAND **H.** The question as to the possibility of *Coal* occurring in Egyptian territory is one of great interest. Special attention may be called to a bituminous coal recently obtained some 60 kilometres east of Akaba, while shales containing carbonized remains and traces of plants are exhibited from Redesia, near Edfu, and GebelSeraj, north of Silwa.

The Brick Industry is widely developed in Egypt, and has been of importance from the earliest historical periods, the Nile alluvium being suitable for the purpose.

Some of the principal bricks used in Cairo are exhibited, those of M. Bircher (near Kafr Ayat) M. Zaffrani and Mieli (in the Bulak and Rod el Farag districts of Cairo), being among the most noticeable and widely employed; sun-dried brick, such as was used in ancient times, is exhibited for comparison.

The making of bricks from the Abbasia limestones and sand under pressure is a newly developed industry.

The determination of the nature of the clays and sands now being deposited by the Nile, and the character of the high level clays formerly deposited by the river is of economic importance.

Specimens collected for the purpose of study are here exhibited. Attention may also be called to the black sand, rich in magnetic iron, which is often found in the river deposits.

The Salt Industry is one of wide extension in Egypt, nearly 70,000 tons of Salt being obtained annually by the Salt and Soda Company from their salines in the Lake Mareotis at Mex, near Alexandria, and from the Wadi Natrun.

No. 10188 is a layer of Salt cut out from the layer formed on Lake Abu Risha, and 10189 is the Sodium Carbonate (Natron) from Lake Zugm, both lakes being in the Wadi Natrun.

Smaller specimens of the salt and natron, also presented by the Directors of the Company, are shown in the Mineral Gallery.

The Pottery Industry in Egypt is illustrated in Stand **I** by:—

1. The Nile Clay used locally at Bulak and other localities.
2. The flood deposits formed during rain-storms in the valleys issuing from the desert are also sometimes employed. The Tura clay is an example of this type.
3. The centre of the Pottery Industry is in Upper Egypt, certain beds of the Esna Shales (which have their main outcrop between Qena and Sharawna, south of Esna) being specially suitable for the making of the characteristic water jars (qulahs, balas and zirs), and also for the pottery used in the sakias and pigeon houses.
4. Shales and Clays of similar nature also occur interbedded with the sandstones, as near Aswan, Korosko, etc. and are locally worked.
5. A white porcelain clay, derived from the breaking down of a gniess is obtained nnar Aswan, and is now being tested by a company with a view to the making of finer classes of pottery.

In Stand **J** the exhibit illustrates the relations of the metallic minerals and precious stones of the Eastern Desert. They include:

1. The Country Rocks in which the gold-bearing veins occur, including examples from the Atolla, Semna, and Aradia mines, between Qena and Qosseir, and the well-known Um Rus mine.
2. Copper-silicates, etc., in quartz from Wadi Samrah, Eastern Sinai.
3. Galena (Lead Ore) from Gebel Rossas, near the Red Sea coast about 110 kilometres south of Kosseir.
4. Egyptian Emerald (or Beryl) in quartz, and the gneiss underlying the schists containing it.
5. Conglomerate (Breccia verde antico). This rock was extensively used by the Ancient Egyptians, who specially worked it in Wadi Hammamat, on the Qena-Qosseir road.

Underground Structure in Egypt as illustrated by records from Boring Operations.

An examination of these should begin with Stand **P** near the door, the arrangement following a certain order determined by geographical position.

STAND **P** is devoted to the records from Alexandria and its neighbourhood, and those from some of the more important Delta Towns—Zaqaziq, Benha, Qaliub, and Bordein.

These show that Alexandria is founded on marine deposits, true quartz sand being only present at the maximum depth reached (116 metres). The Abuqir bore presented by W. Lang Anderson Esq., Manager of the Abuqir Co., shows the same characteristics, and the difficulty of obtaining a water supply free from salt in this neighbourhood is thus clearly displayed.

The Royal Society bore at Zaqaziq was made with a view to reaching the older rocks similar to those of the Moqattam Hills; but, as will be seen, unsuccessfully, gravels being still present at over 103 metres below the surface.

In all the records the passage from the alluvial clay to fine sand, and from the latter to gravels with large pebbles should be noted, showing that the Nile formerly carried much coarser material than at the present day. The pebbles are of interest, many of them having been originally derived from the Red Sea hills.

The frequent presence of a second clay below the fine sand in the Delta (see Shamarka, Zagazig railway bore, Abu Akhdar) is of importance in connection with the question of water supply.

STAND **O** illustrates the underground structure of Cairo and its suburbs on the one hand, and the remaining Delta records on the other.

The transition from clay to sand, and from the latter to boulder-bearing gravels is well shown in the Cairo series. In the Giza (Agricultural College) and Kafr Dawar bores the specimens were selected with special care, so that the minor variations are well seen.

The normal succession is modified in the north of the Delta by the former southward extension of the sea (Kafr Dawar and Manzala Mataria), at Helwan by the presence of limestone gravels derived from the desert hills to the east, and at Giza by deposits of artificial origin, due to the area having been occupied by man during long periods of time.

The bore at Kafr Dawar is of interest as ending in a solid white limestone probably similar to the Mex limestone at Alexandria, which is of comparatively recent origin.

STAND **N.** Here are exhibited the records from borings in Upper Egypt, that of Beni Suef being the deepest yet made in Egypt for water. Both in Fayum and Beni Suef the older limestones were reached at an early stage, while the succession of the Nile deposits above them is in close agreement with that of the Delta.

STAND **M** is reserved for bores made outside the Nile Valley area, and at present includes the record of the boring made in Kharga Oasis, presented by the Directors of the Western Corporation Co.

NOTE.—It is hoped that those engaged in boring operations, or the economic development of the mineral resources of the country, will aid in making the economic collection as useful as possible, and on the other hand any inquiry, so far as information is available, will be dealt with. Detailed tables of the properties of the building stones exhibited are hung on the walls between the stands to whose exhibits they apply.

STRATIGRAPHICAL GEOLOGY.

East Room, Upper Floor.

In this room are the fossil records which illustrate the past history of Egypt, those of the youngest beds being in the wall cases on the left hand (north side) of the door. From this point the life of each geological division may be studied in succession, the oldest strata being represented in the case on the south side of the door.

In the table cases the fossils are arranged (1) by age (2) by zoological order, while in the wall cases the geographical distribution is the essential feature.

Geology being as yet a subject so little studied, it may be well to briefly define the meaning of the main geological divisions which are illustrated in this room. The Tertiary epoch is the one in which the animal and plant life first clearly show the characters of the present time; the Mammalia become preponderant among animals, the Dicotyledonous forms among plants, and in the shell-fauna, which is mainly exhibited in this room, the genera are largely identical with those now existing.

A closer study has shown that this identity does not apply to the minor characters, when these are carefully studied, such minor characters determining the *species.* An examination of the strata in Western Europe revealed the fact that species identical with modern forms were less numerous in the Lower than in the Upper Tertiary beds, and on this basis Lyell divided Tertiary time into three systems, the *Eocene*, with only 3 to 4 % of modern species, the *Miocene*, with 17 to 20 %, and the Pliocene with 40 to 50 %. The *Oligocene* system was subsequently intercalated between the Eocene and Miocene to include an important series of strata indicating continental conditions. Further, the term *Pleistocene* has been adopted for strata whose invertebrate fauna is practically identical with that of the present time, but in which the vertebrate life is often very different from that now flourishing. As vertebrate remains are not now numerous, the term Pleistocene has also been extended to strata with a recent shall-fauna which have obviously undergone considerable disturbance or physical change since their deposition.

Pleistocene and recent period.

With regard to the present distribution of Invertebrata three well-marked types are recognizable in Egypt: 1. The Mediterranean type, in which the majority of the shells are identical with forms commonly found on the southern shores of Europe. 2. The Red Sea type, which contains the manifold and beautiful varieties abounding in the waters of the Indian Ocean. 3. The Nile freshwater fauna, which again is absolutely distinctive. So sharp is the separation between the first two faunas, that only three species are regarded as identical, the land connection of the Isthmus of Suez having proved an insuperable barrier to their intermixture.

The first two wall-cases are devoted to the Nile Valley recent fauna, and among these may be noted the *Aetheria nilotica*, which often forms thick beds in the Nile, being sometimes even of practical value as a source of lime (for example, at Wad Medani).

The smaller *Corbicula consobrina* is a typical Nile shell, and its presence in high-level clays above the Nile often bears valuable testimony to the former course of the river. The great Ampullarias are essentially southern forms, being now found as land-shells in the southern Sudan, and also as river-shells in the White Nile. The *Lanistes Bolteni* is also a typical African shell, the genus *Lanistes* differing from that of the common snail, *Helix*, by having its shell wound in a left-handed instead of a right-handed spiral.

In the Fayum (2nd shelf) are a series of freshwater shells, the most widely distributed in Egypt being the *Melania tuberculata*, which is found in almost all places where lakes formerly existed. These shells are common in the neighbourhood of Helwan at the foot of the low plateau north of the golf-links.

In the *Delta* there is an occasional intermingling of brackish-water Mediterranean shells and the freshwater fauna of the Nile, the former also being abundant in the great lakes (Mareotis, etc.).

Of the brackish forms *Cardium edule* is of wide distribution, occurring in thousands on the lake-shores and in the strata underlying Alexandria, Kafr Dawar, etc. (see borings).

The *Mediterranean* fauna is represented by the small collection under *Delta* on the second shelf.

CASE 7.—On the other hand there is a large collection of Red Sea shells from Sinai, these being arranged according to their zoological position in cases 5 and 7. The *Coral* collection has not as yet been finally arranged, but among the Echinodermata, the beauty of form of the modern sea-urchins *Phyllacanthus* and *Heterocentrotus* will be remarked. The flat sea-urchins *Clypeaster scutiformis* and especially *Laganum depressum* are important members of the coral-reefs or raised beaches shortly to be mentioned.

Also note the *Psammechinus verruculatus* found in a beach now high above the Gulf of Aqaba. The *Brissus carinatus* and *Laganum depressum* are no longer found in the Red Sea, but still live near Mauritius.

The Lamellibranchs (bivalves) are widely represented, those which have been figured in any paper being marked with a green label.

The Pectens (3450, etc.) and *Chlamys* (2127, etc.) are at present comparatively rare in the Red Sea, but form a very distinctive feature in the sea-beaches which line the Egyptian coast.

CASE No. 5.—In case 5 are the Gasteropoda (univalves) of Pleistocene and recent age. The large *Ampullaria* from the Fayum (2928[1]) is the type of a new species (types are always marked by red labels). One of the most characteristic of the raised beach shells is the striped univalve *Strombus fasciatus* (2163, 2235).

The large *Dolium* (6086) shows to what a size some of the Red Sea shells may attain.

In the corresponding side-cases attention may be called to the fine specimens of the coral *Orbicella* (4554) from the Sinai coral reefs, the pink organ-coral (*Tubipora musica*, 4771), the large Tridacnas, and sea-urchins, (5311), &c., being also conspicuous.

The next four cases are arranged to show the characters of the Raised Beaches on the Red Sea Coast. Those now 15 and 24 metres above the sea have a fauna markedly resembling that of today, only the shell-colours having been lost; in the higher beaches (72 to 238 metres above sea-level) the shells have in many cases disappeared, the internal mould alone being left. All the evidence in this portion of the gallery points to an *elevation* of the Red Sea coast in comparatively recent times.

Pliocene Period.

Table-Case 3.—The shells here exhibited carry us back a considerable stage in the history of the Nile Valley, as they have been obtained from sea-beaches which occur at intervals in the valley as far south as Minia. The best-known of these is somewhat to the south of the Pyramids of Giza. Of special interest is the large *Clypeaster ægyptiacus* (5886) obtained from this locality.

Put briefly the *Pliocene* is a period of great change in the surface of Egypt. All the evidence now obtained points to tremendous changes having taken place during the middle of this period, the great foldings which determined the Alps and Himalayas only then coming to an end, while in Africa and western Asia these disturbances were represented by the formation of long cracks, which have by their presence determined the principal features of N.E. Africa. Part of the Nile Valley, the Red Sea, the depression of the Jordan and Dead Sea, the great rift-valleys of Central Africa all appear to have come into being at this period, and in forming a picture of the past, this change must be borne in mind. Subsequent to the formation of the Nile Valley depression, its lower portion appears to have passed through five stages, (1) Occupation by an arm of the sea, as illustrated in this case, (2) The sea retiring, leaving lakes, in which, as already mentioned, *Melania tuberculata* flourished, (3) The river enters on the scene bearing coarse gravel and boulders, the Torrent stage, then gradually diminishing its transporting power, forms fine sands, and only in the final stages of its history has brought down the rich alluvium of the Abyssinian hills.

Miocene Period.

Case 1.—Bearing these changes in mind, the Miocene period is marked by material changes in the relations of land and sea, the fossil evidence pointing to a great extension of the Mediterranean in all directions, so that the fossil fauna obtained in the desert between Cairo and Suez is equally present in the Vienna basin, which formed part of this great sea, while in addition the present Black and Caspian Seas were embraced within its bounds. Of the Red Sea and its fauna there is on the contrary no trace, it had not yet been called into being.

As a result of this extension, fossil remains of Miocene age are of the greatest abundance in the desert between Cairo and Suez up to the foot of the higher ranges east of Cairo, and to the west these have been traced as far as the oasis of Siwah. Among the varied life of the period, which has only in recent years been the object of study, attention may be called to the corals, and especially the two new species *Orbicella Humphreysi* (6996) and *Solenastraea anomala* (6664). The sea-urchins are very abundant, flattened types being especially prevalent. Among these note especially the Clypeasters, *C. geneffensis* (6775) and *C. isthmicus* (7787); and the Scutellas (975, etc.). *Echinolampas amplus* (978) and *Pericosmus latus* (6745) are also very characteristic of the Egyptian Miocene.

Case 1.—The Oysters often attain a large size, especially in the southern Miocene beds on the Gulf of Suez (see the *Ostrea gingensis* (N° 787^3), but the most characteristic feature of the period is the abundance and variety of the species of *Pecten* between Cairo and Suez, which often occur in masses in the rock, and are sometimes most perfectly preserved. Note for instance the assemblage from Geneffe, near Ismailia (N° 6967, *Pecten cristato-costatus*), or the beautifully tinted *Pecten Schweinfurthi.* In the Oasis of Mogara, some days camel journey into the Western Desert from Cairo, Miocene beds with a distinctly shallower-water character have been obtained, and so far as their relations can be determined, underlie the strata containing *Pecten*, etc.

Among the sea-urchins attention may be called to the beautiful *Amphiope* N° 7766, and the large bivalve *Mytilus aquitanicus*, both from Mogara, otherwise the fossils from these Lower Miocene beds consist of a somewhat uninteresting series of bivalve moulds or internal casts.

Oligocene Period.

The shallowing indicated in this series is part of the great body of evidence for the existence of an older, or Proto-Egyptian continent, which has left its traces far and wide in the neighbourhood of Cairo. This is the Oligocene Period, which is characterized in Egypt by outflows of lava (1) (including the important basalt occurrences at Abu Zabel, in the Fayum, etc.), and probable geyser action, to which Jebel Ahmar (the Red Hill), near Cairo, is due. The continental characters are further emphasized by the presence of fossil wood in these strata, and especially by the discovery of the remains of the great land animals exhibited in the Vertebrate Gallery.

---

(1) M. Fourtau holds the view that many of these and the Ahmar quartzites are connected with the later or Pliocene movement.

In the end wall-cases is a series of fossil trees obtained from these so-called "Petrified Forests," while on the shelf above are thin sections cut from the specimens underneath, which in some instances still show traces of the cellular woody structure.

Eocene Period.

The majority of the Vertebrata would as regard their age occupy the space between the two eastern wall-cases. One of the large Tortoises is placed here to indicate this fact.

The historical changes occurring previous to this Continental period are admirably illustrated in the neighbourhood of Cairo and in the Fayum, the evidence showing that there was a gradual shallowing of an Eocene sea which formerly extended over the larger part of Northern Africa. Beds of this age have now been recognized in Nigeria and in Somaliland, the limestone plateau from Cairo to Esna (including the well-known cliffs of the Moqattam hills and above Deir-el-Bahari, at Thebes) also belonging to the same series. An examination of the fossil assemblages has led to a further subdivision of the Eocene into a Lower or Libyan, and a Middle or Moqattam stage; the Upper stage, which has no special name (Upper Eocene only), being the one in which the main Vertebrate discoveries have been made.

Owing to the dip or tilt of the beds being northward, the older beds of the Eocene (Libyan) form the cliffs to the south of Assiut, but disappear underground northward, the Moqattam series taking their place. The junction of the Upper and Lower Moqattam is well seen in the escarpment behind the Citadel, the white limestones of the Lower Moqattam being sharply marked off from the brown shallow-water clays, sands, etc., of the Upper Moqattam.

TABLE-CASE 2.—Three divisions of this case are devoted to the fossils of the Upper Moqattam. Among the most characteristic attention may be called to the Astræan corals (2974, etc.) and especially to the remarkable *Qerunia cornuta* (7715) which is only found in Egypt (especially in the Fayum and near Cairo) and whose zoological position has been the subject of much dispute. The two sea-urchins *Echinolampas Crameri* (3178) and *Anisaster gibberulus* (553) are only obtained in the Upper Moqattam strata.

Special attention should be given to the flat oyster *Carolia placunoides* (3031 etc.), one of the most characteristic and widespread of Moqattam shells. It frequently occurs in masses, having the peculiar extension with corresponding perforation in the neighbouring test by which the oysters are enabled to form solid banks resisting the wearing action of powerful currents. A hill at the entry of Wadi el Tih, near Cairo, is practically composed of individuals of this species. *Ostrea Clot-Beyi* (1588) is often present in equal abundance. Other typical Upper Moqattam bivalves are *Plicatula polymorpha* (2359¹), and the *Cardita* (3139) occurring in the greatest abundance in the Fayum.

Among the Gasteropoda (univalves) notice the abundance and variety of the thin tower-shells (Turritellæ) the Cassidarias (2,486⁶ and 2,491³) being also characteristic of the series.

CASES 2 AND 4.—*Lower Moqattam.* The fauna of this period, though not sharply marked off from those of the upper beds, nevertheless displays certain broad differences. Among its most characteristic fossils is the coin-like *Nummulites gizehensis* (7714) which sometimes attains an exceptional size for the group of animals to which it belongs (the Foraminifera). Whole beds may be made up of this species, and small varieties occur in the greatest abundance in the limestones near Cairo. Sea-urchins increase in size and variety; among these the large *Echinolampas africanus* is found at Cairo, and species of the genus *Schizaster* are very abundant.

The multicostate oysters attain exceptional development, many species having been described (see *Exogyra Fraasi*, 450 etc.). Among the bivalves, species of *Lucina* and the razor-shell *Macrosolen* are of common occurrence.

The large *Natica* (481) is the original "horn of Ammon" of the ancients, and special attention should be directed to the crabs from the cliffs of Cairo, a perfect example being shown under No. 9600.

TABLE-CASE 4.—The *Lower Eocene* (here divided into three members, the Upper and Lower Libyan stages, and the Garra-Kurkur series) contains a number of characteristic sea-urchins, many of them heart-shaped (see the *Linthia* No. 864 and *Schizaster* 865). No. 630 is the type-specimen of the widely distributed bivalve *Spondylus ægyptiacus.*

In the Lower Libyan series are a number of species which are of widest distribution in Upper Egypt. Special attention may be called to the beautifully preserved type-specimen of the sea-urchin *Rhabdocidaris libyensis*, while the large size of the species of *Conoclypeus* will attract attention. The *Megapneustes Sickenbergeri* (201) is another interesting form whose place of origin has never been re-discovered since it was first obtained by Prof. Mayer Eymar. The large *Lucina thebaica* (874) will be familiar to those visiting Luxor, and on some of the hill-slopes in Upper Egypt this shell is of the commonest occurrence.

The Garra-Kurkur series of fossils was obtained by Sir W. Willcocks south of the Kurkur oasis, and is of interest owing to the shallow-water characters of the shells present, whereas the Libyan fauna as a whole indicates deeper-sea conditions.

In the wall-cases the geographical distribution of the various Eocene divisions is represented, and attention may be directed to the large Nautili from the Tura Middle Eocene Limestones. Of special interest is the unique specimen of the branching coral *Astrohelia similis* (4696) from the Fayum; the large oyster in front from the same locality shows the large size to which these sometimes attained.

Cretaceous Period.

Case 6.—The Cretaceous strata wherever studied are markedly distinct from those of Eocene age, very few species being common to the two series. Broadly speaking during the former period the large Reptiles flourished, while the Mammalia were still but feebly developed. Among the invertebrata characteristic groups disappear absolutely at the end of the Cretaceous, especially the Ammonites. An interesting feature is the close resemblance of many of the Egyptian species to those of the Chalk in Western Europe, and all the evidence points to the deposits having been laid down under similar conditions viz. in a sea of considerable depth. As in the case of the Eocene series, the Cretaceous sea has no relation to present surface conditions, the Continental border of Africa lying far to the south of Egypt. In Europe the Cretaceous Period has been subdivided into an Upper and Lower Division, the former alone being represented in this country.

Further subdivisions have been found necessary, and by the majority of writers the following have been recognized in Egypt:

1. *Danian.*
2. *Campanian.*
3. *Santonian.*
4. *Turonian.*
5. *Cenomanian.*

These indicate phases of one great geological event, the gradual advance of an oceanic area over the north-east of Africa.

Case No. 6.—In the Danian (¹) or uppermost division this movement is at its maximum, Case No. 6 containing the delicate fauna

---

(¹) These beds were first recognized in Denmark.

from the Great Oases which by the abundance and variety of its forms already marks a secondary shallowing. The deepest-water shells are those obtained from a very marked white or yellow limestone, which is widely developed in the Oases and in the Nile Valley near Esna. Special attention may be directed to the Sponge *Ventriculites poculum* (9713) and the sea-urchin *Echinocorys vulgaris* (9710) from the Kharga Oasis which are identical with genera from the White Chalk of England, France, Germany and Russia. Some of the corals are well preserved, see *Coelosmilia laxa* (1471) and Oysters of large size have also been obtained, *Ostrea Osiris* (9709).

In the Lower Danian shales many of the fossils have a peculiar dark brown colour, owing to the replacement of the carbonate of lime of the shells by iron oxide.

Where shales of this age are developed, shells of this nature may sometimes be obtained in remarkable numbers.

The fauna includes many corals (see Nos 7567 to 7600, etc.) crinoid stems (7605 and 7606), sea-urchins (7607 and 7608) and Brachiopods (7610). The bivalves are widely distributed, the large *Exogyra Overwegi* (9708) being characteristic of certain limestone beds in the Oases, while the species of *Nucula* (7626) and *Leda* (7630) are as widely distributed in the shales.

Among the Gasteropoda (univalves) the most typical is the *Alaria Schweinfurthi* (7677), and among the Cephalopoda we now meet with the Ammonites (*Libycoceras Ismaeli*, 7699). Fish-teeth and bones are abundant in the lower beds of this series; note especially the teeth of the sharks *Lamna rapax* (7704) and *Otodus smilodon* (7705).

At the base of the Danian strata are a series of limestones of *Campanian* (1) age, marked in Egypt by the wide distribution of the oyster-beds, and by the presence of phosphatic deposits due to the aggregation of fish-remains. The large *Ostrea Villei* (1749) is obtainable in hundreds from a stratum at Bir el Beida, near Qosseir, the large bivalve *Trigonoarca multidentata* (type-specimen 1044^2 is in this case) being equally abundant. The external cast of *Ptychoceras* (1686) is of interest as having been the fossil by which the Cretaceous age of the phosphatic beds was first determined. Starting from this basis, it has since been shown that wherever beds of Campanian age have been obtained in Egypt phosphatic strata are also present.

The type fossil of the phosphate deposits is the shark *Otodus biauriculatus* (2286^5).

(1). The type series occurs in the old province of Champagne, in France.

CASE 8.—Speaking generally the Cretaceous beds are best developed in Upper Egypt, the Oases, the desert region between Qena and Qosseir, and in Jebel Ataqa, near Suez, but an island of this formation has also been preserved in the immediate neighbourhood of Cairo, forming the hill range of Abu Roash, north of the Pyramids. The strata best developed in this region are somewhat older than those just examined, and by comparison with the type localities in France have been referred to the Santonian and Turonian divisions. The *Santonian* strata are very fossiliferous, and attention may be directed to the well-preserved oyster (see *Ostrea acanthonota*, 5032^1). The minute sea-urchins 9517 to 9519 should also be noticed, and Ammonites of the genus *Tissotia* (52) are of frequent occurrence.

The *Turonian* beds are characterized by reefs of the remarkable bivalve *Biradiolites cornu-pastoris*, which has never been obtained in strata younger than the Cretaceous, while of equal abundance are the shells of *Actaeonella Salamonis* and *Nerinea requieniana.*

The lowest division of the Cretaceous represented in Egypt, the *Cenomanian*, has attracted much attention among geological students owing to its wide distribution and the variety of its fossil contents. It has now been traced from Eastern Sinai to Baharia Oasis, being also well-developed in Western Sinai and the North-Eastern Desert of Egypt. Among the most characteristic of its fossils may be mentioned the heart-shaped sea-urchin *Hemiaster cubicus* (5287 and 7473, etc.), and the abundant Sinai sea-urchin marked as *Linthia oblonga* (3614). From Baharia Oasis note the beautiful regular sea-urchins *Rhabdocidaris Bonolai* (1536^1) and *Cidaris Thomasi* (1536^2). The oysters are very characteristic, the four most noticeable species being the *Ostrea olisiponensis* (1502) from Baharia, the *Ostrea suborbiculata* (7479) from Gebel Ataqa, the *Ostrea flabellata* (see Baharia Oasis in wall-case) and the *Ostrea Rouvillei* (4997^4) from Eastern Sinai. A remarkable curved form of the latter has been obtained in Baharia Oasis, where the Cenomanian beds have also yielded the Ammonite *Neolobites Vibrayeanus* (1459) and some interesting dicotyledenous leaves (1448).

In the wall-cases special attention may be directed to the well-preserved Ammonite *Indoceras* (3189) from Kharga Oasis.

In all cases where observed the Cenomanian strata are immediately underlaid by the sandstone, which under the name of the *Nubian sandstone* extends from south of Esna to beyond Khartoum and the borders of Abyssinia. This great and on the whole unfossiliferous formation marks the near presence of an extensive continental area, and has been regarded by some writers as itself a desert land formation. The most characteristic fossils present are the silicified remains of trees exhibited in the wall-case near Case No. 8, the thin sections on the middle shelf having been cut from the specimens arranged below them.

In Egypt there is a great gap in the life-history, no records of the Jurassic, Triassic, and Permian periods, (in Europe so rich and varied in their characters) having been obtained. In Africa the nearest Jurassic strata are in Abyssinia. Of late years certain scattered localities in the Eastern Desert (Wadi Araba) and Sinai have yielded a fauna of *Carboniferous* age of deep interest, but not of very attractive appearance. Unfortunately up to the present there is but little evidence of the existence of the plant-life which led to the formation of the most important coal-bearing areas in Europe. Attention may, however, be called to the fern 1423 from Wadi Araba, and the *Lepidodendron* stem in the end wall-case near the door. In the latter note also the *Syringopora* No. 3887, the coral *Zaphrentis* 3989, and members of the genus *Spirifer* 3981^2.

As to the presence of still older beds of Devonian, Silurian, Ordovician, or Cambrian age the Egyptian fossil records are silent, and the attempt to classify the older sedimentary strata which are known to exist in the desert regions by their external resemblances to strata of similar appearance in Europe must be regarded as premature and possibly misleading.

PALÆONTOLOGICAL GALLERY.

Central Gallery, Upper Floor.

This portion of the Museum is largely devoted to the exhibition of the large Mammalian, etc., remains discovered in the Fayum, a discovery of the greatest interest owing to the size, abundance, variety, and geological age of the specimens obtained.

Before proceeding to a description of the vertebrate remains, attention is directed to the geological maps exhibited in this room.

Geological Maps.

1. *Abu Roash.*—To the north of the Pyramids is the hill-range of Abu Roash, which is of interest as being an island of Cretaceous rocks present in the immediate neighbourhood of Cairo. With this exception, the nearest occurrences of strata of this age are near Qena to the south, and Suez (Jebel Ataqa) to the east. The strata here are much disturbed in position, and are overlaid by horizontal or slightly dipping Eocene beds (coloured blue), similar to those of the Moqattam cliffs on the opposite side of the valley, and in which the coin-like *Nummulites gizehensis* may be obtained in quantity at certain localities. The Eocene beds in their turn are overlaid by the sands and gravels of the Oligocene, often containing silicified wood. The pink-coloured portions indicate the presence of interbedded lavas (basalts), evidence of volcanic action during this earlier continental period.

2. *The Great Oases.*—The boundaries of these depressions well display the geological succession: (*a*) In *Kharga Oasis* the summit of the plateau is formed by Eocene limestone (deep blue), beneath them on the slope being a series of shales and a characteristic white Chalk (the fossiliferous Cretaceous beds) while the base of the oasis is formed of Nubian sandstone.

In the N. W corner note that the White Cretaceous limestone is forming a secondary plateau, which in (*b*) *Dakhla Oasis*, becomes the main cliff. The oases owe their origin to wells, which in both cases are in the Nubian sandstone, but in Dakhla are on an east-west line, whereas in Kharga they trend from north to south. The importance of blown sand dunes is indicated on both maps.

(*c*) *Farafra Oasis* is geologically at a higher horizon than those previously mentioned, the base of the oasis being in the White Chalk, that is in the stratum which forms the summit of the Dakhla Oasis cliff.

On the central pillar, note:

4. *Aswan Neighbourhood.*—This map shows the limited development of the igneous rocks at Aswan (¹) and Kalabsha, and the wide extension of the overlying Nubian Sandstone in Upper Egypt.

To the west the escarpment of the hill range of Jebel Abdurma displays the ascending succession of the Cretaceous series capped by the Eocene beds, which form the higher portion of the western desert plateau overlooking the Nile from Cairo to far south of Esna.

5. *Eastern Desert.*—Near the door of the Stratigraphical room is a map showing the complicated relations displayed in the Eastern desert east and north-east of Qena between the Nile and the Red Sea. Fundamentally the country consists of a central axis of igneous, metamorphic, and ancient sedimentary rocks which trends north-west and south-east, including most of the important mountain ranges of Egypt. The oldest rocks are the schists (Sch) and volcanic rocks (*A*), these including the famous Imperial porphyry area of Jebel Dokhan (marked Porphyry Quarries). Underlying these is the granite, which further north occupies the greater portion of the region and in the centre of the map gives rise to a mountain massif whose highest summits attain an altitude of over 2000 metres. The relations of the granites and schists, etc., to one another are of great practical importance, the old mines being in close proximity to the junction of the two rocks, and especially in the diorites and hornblende-granites developed near the line of contact (see Semna, Atolla, Aradia, etc.).

The Romans worked the granite for pillars, etc., at Mons Claudianus, and to the north near Jebel el Urf and the Dara range are old workings for copper and iron. Whether gold is also present in the northern part has yet to be more fully tested, but the area forms part of a concession.

The normal sequence is shown in the south-west corner of the sheets, younger beds being superimposed on one another successively from east to west owing to the westward dip of the strata. Taking the lowest schists as No. 1, the order of succession upward is 2. Granites, etc. 3. Nubian Sandstone (N). 4. Cretaceous fossiliferous

---

(¹) The eastern border of the Aswan granite area has yet to be determined.

limestones (S). 5. The Esna Shales (E.S.) underlying 6. The Eocene Limestones, E.

To the east of the central axis may be noted the two small-scale repetitions of the central axis whose presence is due to fractures, and in the south-west the development of raised coral-reefs (C. R.) and hills of gypsum (G).

At Jebel Zeit, near the north-east corner, are the petroleum wells, and at Jebel Kabrit, the former sulphur workings.

5. The large detailed sheet of *Jebel Duwi* shows the effect on the strata of the fracturing to which the country near Qosseir and bordering the Red Sea has been subject.

6. *Jebel Zeit.*—The petroleum area has been specially mapped. This locality is also of interest because the range, which in the normal succession would be a limestone is now entirely composed of gypsum, the change being obviously related to the former extension of the sea over the now elevated area.

7. The *Ras Jemsa* map illustrates the importance of the raised coral reefs and indicates the position of the abandoned sulphur mines.

Vertebrates from the Upper Eocene of the Fayum.

The place of honour is occupied by the head of the huge herbivore *Arsinoitherium Zitteli*, first discovered and made known to science in 1902. Of the five heads hitherto obtained three are here exhibited, and the special characters will at once attract attention. Of these the most noticeable are the presence of four bony horn-cores, and the enormous development of those in front. The grooving of the teeth is also a feature of interest. The skulls are of two kinds, the horns of No. 8128 being sharp-pointed, while in Nos. 8130 and 7805 they are well-rounded. No. 8130 is of interest as being the first record of this new genus (type–specimen), while No. 7805 displays the youthful characters, not yet having cut its final molar. Attention may be further directed to the size of the pelvic girdle No. 8413 (in special case opposite southern door). The *Arsinoitherium* collection is of a very complete nature, the wall-case to the right of the southern door containing two scapulæ (shoulder-girdles), numerous examples of the humerus (upper arm-bones, whose solidity should be noticed) also the ulna and the radius of the lower arm, many examples of these being shown on the lower shelf. In front of these are exhibited a series of ribs, and the smaller hand-bones are placed on sloping stands on the middle shelf.

In the left hand southern wall case are the leg-bones, including two fine femurs, a good series of the tibia, the rare specimens of the fibula, and a complete vertebral column. The foot-bones and patellæ on the middle shelf complete the series. It is thus possible to make a model of this remarkable herbivore, the only difficulty being in connection with the formation of the hand and foot, the precise relation of whose small bones are difficult to determine.

The western wall case is at present devoted to the oldest of known elephants, the *Palæomastodon Beadnelli*, which forms the first number of a remarkable series (admirably illustrated in the British Museum) terminating in the modern elephants. Points deserving of special notice are the prolongation of the lower jaw (greatly exaggerated in the French Mastodons). There being no corresponding extension of the upper jaw, it has been held that the latter was represented by a soft upper lip, which in the Mastodons was lengthened to an unusual extent, and when the lower jaw lost its prolongation, as in present day elephants, persisted as the trunk.

The large size of the Fayoum *Tortoises* is also a feature of interest, these vying in this respect with those of the Galapagos Islands and Madagascar. Very perfect examples of the new species, *Testudo Ammon*, are placed in the eastern case. The arrangement in this case is of a temporary nature, as some fifty new species, now being studied in London have to be provided for. The upper portion of the eastern case is devoted to the remains of *Zeuglodon*, an animal which has long been regarded as a toothed whale, though some writers are inclined to regard it as a carnivore which has adopted the aquatic habit. Among the more conspicuous of these exhibits is a fine skull (¹), a portion of the lower jaw showing the characteristic structure of the teeth, and one of the large-sized vertebræ. The smaller vertebræ on the upper shelf have still to be mounted.

In the table cases (following from left to right) are a number of specimens temporarily arranged. Among these attention may be called to the back of an *Arsinoitherium* skull, showing interior of brain cavity, and two portions of the hollow horn-cores which display the internal thickenings.

In the next division are jaws and limb bones of *Palaeomastodon*. In the table case between the pillars attention is directed to the long-nosed crocodile *Tomistoma*, mounted on plaster. In the East central case are remains of a *Hippopotamus* (No. 4718).

In the same case are a number of smaller mammalian remains, including

---

(¹) At present in London for study.

*

jaws of a small carnivore (*Ancodus*, see No. 8983). The majority of the small jaws in the last division belong to the ancestors of the modern Coneys. Previous to the discovery of these new genera *Megalohyrax* and *Saghatherium*, only one fossil coney was known, having been recorded from Greece.

Miocene Vertebrata.

The Eastern table-case contains an interesting series of Vertebrate remains from the Lower Miocene beds of the Oasis of Mogara, situated in the Western Desert six days camel journey from Cairo. These will be finally arranged when the whole of the Mogara collections have been studied.

View of *Cairo* from *Geological Museum.* A stair case in the small southern room in the south-eastern corner of the gallery leads to the roof, from which an extensive view of Cairo is obtained. Among the noticeable features are the Citadel and the cliff-wall of the Moqattam hills. In suitable lights the division of the latter into a white lower portion and brown-red upper portion will be observable. This difference is due to the more definitely marine character (white limestone) of the Lower Moqattam (¹) series, the Upper Moqattam (¹) beds above being of shallower water origin, as evidenced by the darker-coloured sands and clays to which their deeper tints are due. It will be seen that these beds of Middle Eocene age are gently dipping northward (in reality north-westward), so that each bed in succession passes under the surface.

(¹) The names Upper and Lower Moqattam have been adopted for the divisions of the Middle Eocene in Egypt as convenient local terms.

PETROGRAPHICAL GEOLOGY.

West Gallery, Upper Floor.

This gallery is devoted to the Minerals and Rocks of Egypt, the plan being shown on a scale index near the door. The side-cases are still under arrangement, the table-cases are marked by gilt numbers on the end facing the door.

(A) **Minerals.**

CASE 14 contains the minerals of the heavy metals (Gold, Copper, Manganese, Iron and Lead), the precious stones, sulphur, and certain sulphur compounds from the Oases.

Special attention may be directed to the native Gold in Quartz from the Um Rus and Um Garaiart gold Mines (1): the Copper silicates (Chrysocolla) from the workings at Wadi Samrah, in East Sinai; the Manganese ores of Sinai; the Micaceous Hæmatite (Iron Oxide) from Wadi Dib, in the Northern Red Sea Hills; the Magnetic Iron (Magnetite) octahedral crystals from the Heggate district, and the Galena of Gebel Rossas near the Red Sea, 110 kilometres south of Qosseir; the Egyptian Emerald of Jebels Zabara and Sikait, the Sulphur of Ras Jemsa, and the Alums deposited round the wells in Dakhla Oasis.

The Gold Mines now being worked are all situated in the eastern desert of Egypt between latitudes 22° N. and 28° N. The Copper ores have also been extensively worked in the past both in Egypt and Sinai, there being ancient workings in central Sinai, in the Northern desert of Egypt near Jebel Gharib, south-east of Aswan and east of Edfu in the Hamata range. The Iron ore has been apparently also exploited in the Wadi Dib region near Jebel Gharib, and at Abu Jerida, on the northern Qena-Qosseir road. The Egyptian Emerald (beryl) of Zabara, south of Qosseir, were of economic importance in ancient times, and the workings are being reopened. The

---

(1) These mines have now reached the producing stage.

Sulphur of Jemsa was worked for a short time, but owing to the small amount present, the effort has been abandoned.

The Alums are in the Western Corporation concession area.

Case 13 contains (1) Quartz and the Silicates (2) Carbonates (3) Sulphates (4) Haloids and Phosphates.

Among the Silicates special attention may be directed to the geodes containing crystals of quartz and calcite obtained near Qasr el Sagha in the Fayum; the Chalcedony and the hydrous silicate Natrolite from cavities in the basaltic lava of North Abyssinia, and a peculiar variety of coaly-looking Tourmaline in quartz-veins near Kosha, south of Wadi Halfa. The agates from Karnak Temple are of archæological interest.

Among the Carbonates, Calcite (Carbonate of Lime) plays the principal part. Specially noticeable is the rhombohedral variety from Assiut (Iceland spar); the scalenohedral crystals (dog tooth spar) from Wadi Esbeh, in Western Sinai; and various massive varieties including the so-called Egyptian "Alabaster." True Alabaster is a hydrous sulphate of lime, the word alabaster as applied to the Egyptian carbonate of lime is therefore, strictly speaking, a misnomer.

The Sulphates are widely distributed in Egypt, hydrous sulphate of lime being present both in its crystallized form (selenite) and in the fibrous types (gypsum). Specially noteworthy are the long selenite crystals obtained near Schweinfurth's Temple in the Fayum, and the fibrous variety from Baharia Oasis. Its economic importance has already been mentioned.

The Sulphate of Strontium (Celestine) is of local interest as it occurs in abundance in the beds capping the Moqattam hill behind the citadel. Some of the fossils in the Fayum are entirely replaced by this mineral.

Sulphate of Barium (Barytes or Heavy spar) is represented by well developed crystals from Baharia Oasis, and compact varieties from Western Sinai and Wadi Dib in the Eastern desert.

On the Gabbari road between Dakhla and Kharga, the sandstone has taken the place and form of barytes crystals.

The Haloids include Rock Salt, the cubic crystals of this mineral, and especially the open-work type from Wadi Natrun, being of interest, as are also the fibrous varieties from the desert north-east of Matma, near Assiut, and west of Sheikh Fadl, north of Minia.

The varieties of Sodium Carbonate obtained from Wadi Natrun are also exhibited here, including the best quality Sultani variety.

The phosphates, bone beds made up of fish-remains, are widely distributed, specimens from the Dakhla Oasis and region on the east bank of the Nile south of Esna illustrating these deposits.

Many of the minerals in this case are of economic importance in Egypt; the limestone, gypsum, salt, carbonate of soda, and the phosphates being at the present time the objects of important concessions.

(*B*) **Rocks.**

Rocks fall naturally into three divisions, viz:—

(1) Igneous (2) Metamorphic, and (3) Sedimentary Rocks. The first of these is separated on the basis of chemical composition and mineral structure into the Acid Rocks marked by the abundance of silica and potash-bearing minerals, the Basic Rocks possessing a predominance of lime and iron-containing minerals and the Intermediate Rocks, as their name implies, occupying a position midway between the other two divisions.

The Metamorphic Rocks are similar in mineral composition to the Igneous Rocks, but have developed a foliated structure, the constituent minerals being drawn out in bands which somewhat resemble the layers of a stratified rock, but which, when closely examined, are seen to curve, appearing in some cases to flow round the larger mineral components.

The Sedimentary Rocks are as their name implies, broadly speaking, sediments originally deposited under water, and are either of organic origin, being built up of the shells, i.e., of animals once living in river, lake, or sea, or consist of materials derived from the igneous rocks resorted and deposited under water.

Case 16 is devoted to the Acid rocks, which are separated into three main types depending on their mode of origin.

1.—The Granites, which have cooled slowly at great depths, enabling the constituents to form more or less well defined crystals. 2.—Quartz Felsites produced when heated material of similar composition to the granites is injected into fissures in the earth's crust, forming bands known as dykes. Owing to the more rapid cooling, they are composed of a fine-grained base (in which crystals can only be distinguished under the microscope) through which are usually scattered crystals of larger size, often derived from the deep-seated source of supply. 3.—When rocks reach the surface, the cooling is exceptionally rapid, and they tend to form glass of various compositions(often resembling dark bottle glass). Structures are also frequently present showing that the rock has flowed as lava over the surface. Those of acid composition are known as Rhyolites. These volcanic rocks played an important part in the geological history of Egypt and the Sudan.

Two divisions of the case are devoted to the Granites, which are further subdivided geographically. At Aswan the series to the extreme left shows the change from the unaltered "Monumental Granite" to a highly altered green coloured product. In the first-named note the glassy mineral, Quartz, the flesh-red crystals of large size, Orthoclase or Potash Felspar, and the black shiny flakes of Mica. In the next specimen the red felspar has undergone change to a white decomposition product Kaolin, which is a very pure porcelain clay. In Nos. 4712 and 4713 both Felspar and Mica have undergone extreme change.

When Quartz and Felspar alone are present, mica being absent, the Granites are usually known as Aplites, these commonly occurring as broad veins rather than in large masses. When the Quartz and the Felspar are both large, the rock is usually termed a Pegmatite (4548).

While the red-coloured granites are the most characteristic, the Felspars are often light in colour, and the rock then has the speckled appearance seen for instance in No. 4622.

Red Granite plays a most important part in the mountain ranges of Eastern Egypt, the Sudan and Sinai, No. 2274 being the component rock of the highest mountain in Egypt, Jebel el Shayeb, near the Red Sea, north of Qosseir.

In the Eastern Sinai Section are exhibited specimens of Hornblende-Granite, in which the place of the mica is taken by the black prismatic mineral hornblende (4816), or the somewhat rare mineral Riebeckite, belonging to the same mineral group as hornblende.

The great development of granites in the mountain regions of Egypt is shown on the map of the Eastern Desert hung on the eastern wall of the Central Gallery, and their distribution at Aswan is shown on the Aswan map (northern pillar of same room). The coarser Granites may be easily identified by their mineral constitution and their specific gravity, while finer varieties have to be examined under the microscope. The regions where they are present are characterised by the peculiar boulder-strewn character of the hills (well-marked at Aswan) or by the saw-like character of the higher mountain crests, which with further weathering become rounded summits with steep smooth slopes. The valleys in the Egyptian granitic region are usually comparatively rich in vegetation, and waterpools are relatively abundant.

Quartz-Felsites.—One of the most interesting physical features in Egypt are the dykes which seam the hills in the central mountain region, and which when closely set together give rise to a particular type of scenery, low ridges capped by reddish-coloured crests extending for many kilometres in parallel lines. This has been termed dyke-country in the Survey reports. Many of these dykes are of brick-red colour and sometimes of a fairly coarse grain (No. 1138 and 4310), while in other cases close inspection reveals crystals of quartz and felspar in the red groundmass. These rocks are known as Quartz-felsites (see Nos. 3903 and 4825) and are of wide distribution throughout the mountain regions of north-east Africa.

Acid Volcanic Rocks.—The investigations of recent years have shown that the Volcanic rocks played a most important part in the ancient history of Egypt. Special attention may be called to No. 8759, 8760, etc., which show the fluidal structure produced in molten lava while slowly solidifying during movement over the surface, closely associated with them being the agglomerates composed of fragments blown out from volcanic vents, and similar to those found in the volcanic regions of to-day. Similar banded rhyolite lavas are exhibited from the Red Sea Hills and Sinai, showing their wide extension in North East Africa.

It is unnecessary to insist on the economic importance of the granites, these having been one of the most widely used of Egyptian ornamental stones in the past, while at the present time they constitute one of the principal rocks used in works requiring stability and strength, the Aswan Dam being in the main built of granite from the neighbouring hills.

Intermediate Rocks.

Case 15.—Closely related to granites in coarseness of grain (holo-crystalline structure) is a group of rocks which differ from them in mineral character, quartz being rare or absent, while hornblende becomes in many cases one of the important constituents. This intermediate group separates naturally into two branches, the Syenites in which the felspar is orthoclase (the potash felspar), while in the Diorites the lime-soda felspars (Plagioclase felspars) take its place. Each of these divisions have corresponding fine-grained dyke-rock and volcanic members, the Trachytes being the lavas of the syenitic series, the Andesites those corresponding to the Diorites. As already stated, the latter are characterised by the glassy nature of a portion of their base, though a secondary crystallization may frequently mask these features.

The Syenites are of wide distribution in north-east Africa, among the more notable specimens being the varieties from Aswan (4503 and 4537), and the types with large hornblende crystals from East Sinai (3460 and 3424).

The corresponding group of dyke-rocks (Syenite-Felsites) are also well represented, the pink and red types, such as those from the Um Rus Mine (7700), and Wadi Yena in West Sinai (3867) being specially characteristic. Attention may also be called to a grey variety from Wadi Aqr, in West Sinai (3997).

The Diorites are of much importance in Egypt, being widely distributed in the Eastern Desert region. Some of these rocks are of ornamental value, the speckled variety from Aswan (4500) being conspicuous in this respect. This character is due to the even distribution of the white plagioclase felspar and the prisms of black hornblende.

Attention may also be called to the quartz-diorites (1719 and 1839), the former having been worked by the Romans at Mons Claudianus and in Wadi Semna, in the desert region north of the Qena-Qosseir road. Here belong the greater number of the rocks roughly described as "Grey Granites." (See No. 3931.)

The Lavas connected with this series are of special interest in N.E. Africa, as they belong to a Volcanic Series anterior to the intrusion of the main masses of granite, and include the Imperial Porphyry of Jebel Dokhan (in the desert north-east of Qena), which, owing to its exploitation by the Roman Emperors, is found as an ornamental stone in all parts of the Roman Empire (5212). Its colour is due to the presence of a manganese-bearing mineral, withamite, a form of epidote, and the rock itself is, so far as known, entirely restricted to the desert region of Egypt above mentioned.

The summits of some of the principal mountains in Sinai are also capped by andesites, No. 7716 being from Jebel Zebir, the highest mountain in the peninsula.

Lavas of Andesitic and Basaltic nature also play an important part in the formation of the Abyssinian mountain plateau, (9181). In No. 9156 the holes originally produced in the lavas by the escape of the heated gases have been subsequently filled by chalcedony and other hydrous silicates. (See also Nos. 9124 and 9180 in case 13.)

Basic Rocks.

Case 10.—The Basic Rocks are marked by the increase of minerals containing lime and iron, the Felspars present being those most rich in lime, such as Labradorite, while among the ferro-magnesian silicates hornblende is in large measure replaced by augite, the two minerals in question having marked physical differences when studied under the microscope.

Another important constituent in these rocks is magnetic iron oxide while quartz and potash felspars are, except as secondary products, practically absent. These rocks are marked by their darker colour, greater specific gravity, and in survey work often have a marked effect on the compass.

As in previous cases, these fall into coarse-grained types, which are known as Gabbros, finer-grained varieties including the great group of the Dolerites, and a series of basic lavas, the Basalts.

Basic rocks are very conspicuous as dykes in the granite, etc., and at Aswan (4549) their weathering has given rise to grooves and channels in the river bed.

The Basic rocks (with the Diorites) are also the main components of the Second Cataract near Wadi Halfa, the dark colour of that region being in sharp contrast to the light tints of the Aswan Cataract. The Gabbros are often extremely hard, the chief flood cataract near Wadi Halfa being due to the wearing away of a soft dyke which traverses the hard basic member No. 4583. Some of these rocks show the effects of the river polishing in a striking manner.

The majority of the specimens show no marked characteristics, but attention may be directed among the Red Sea hill rocks to the Gabbros and Norites of Wadi Semna (1747) and Wadi Zeidoun (1008), and to the Serpentines (1006 and 1944) from the neighbourhood of the Qena-Qosseir road. The Dolerites and Diabases are also widely distributed in Sinai, the latter (which are altered dolerites) often weathering in a spheroidal manner and producing grooves, which form natural roads up many of the otherwise difficult peaks.

There is a group of dolerites and basalts of much interest, viz., those which have intruded into or are interbedded with the sedimentary rocks. To this class belongs No. 6145, by whose action the sandstone, near the contact has developed a well-marked columnar structure.

Basalts are also found in the immediate neighbourhood of Cairo (1325 and 3678), those of Abu Zabel being of economic importance as supplying all the road metal of the city. In Baharia Oasis (1504, etc.) is another interesting development of this basic series, and it has now been recorded from many localities in the Fayum, Nile Valley, Cairo-Suez desert, etc.

The hardness of the basic rocks is an important factor in connection with their employment for economic purposes,

Metamorphic Rocks.

CASE 9.—The Metamorphic Rocks are of special interest owing to their wide development in the Cataract regions and the Sudan.

They fall naturally into two main divisions: 1. the Gneisses, which in their mineral composition closely resemble the coarse-grained members of the Igneous series, especially the Granites and Diorites, and 2. the Schists, whose layers are much more closely set. The presence or absence of felspar is a useful microscopic test, this mineral being very rare in the schists. One of the most widely distributed types of gneiss in Egypt and the Sudan contains well-marked layers of mica (see Aswan, 4343) and 6141 (in the Third Cataract region, north of Dongola) but an inspection of the case will show how varied the series may be in appearance and structure.

Special attention may be called to the highly contorted forms from near Qosseir (2108) and Wadi Waireh, in East Sinai (3436). The Mica and Hornblende-Schists are widely distributed in south-east Egypt. Among the more interesting examples are the mica-schist of Aswan (4354), and the schist containing small garnets from the same locality (9203). South of the Qena-Qosseir Road are highly contorted mica-schists in Wadi Shalool (1080), purple slates from Wadi Zeydoun (1029), and Talc-Schists from Wadi Shalool (1069). A typical hornblende-schist is exhibited from Wadi Barq (3658), and the schists with large garnets from Wadi Hebran (4055, 4178), both localities in West Sinai, should also be noted.

From East Sinai are a group of rocks resulting from contact changes where a molten magma (now a granite with gneissose structure) has intruded into ancient sedimentaries (volcanic ashes, sands, clays, etc.). In 4323, from Jebel Um Zegeer the contact mineral Andalusite (in long imperfectly formed prisms) may be noted, in 3426 from Jebel Akhmar secondary garnets are dotted throughout the schist, and in 4812 from Jebel Um Zegeer is a knotted slate similar to those occurring in European contact-areas of similar character. Of considerable interest are the Marbles, associated with the schists and gneisses in the Eastern Desert of Egypt and the Sudan. Note especially the white marble from Atafla, South Eastern desert (9525), also from the western desert near Kabodi, Third Cataract (6127), and the grey variety from the North Eastern Desert near Jebel Gharib (2302).

Dolomites occur in well-marked ridges in the Amara Cataract district, between Wady Halfa and Dongola.

Sedimentary Rocks.

Case 12.—The Sedimentary Rocks are those which will most come under the observation of visitors to this country, and among those composed of remains of organisms the Limestones, forming the cliffs bordering the Nile Valley from Cairo to Esna, are one of the most conspicuous features.

These calcareous rocks occupying so wide an area are naturally of very varied character. In some cases they become highly crystalline, constituting marbles (see No. 9598 from Wadi Um Damarana, in the Galala Hills, south of Suez). The Breccia found near Luxor, etc. (5144, 2299, etc.), has already been mentioned, p. 6.

Of economic interest, too, is the impure limestone from near Soba Temple, above Khartoum (7718) as it supplies the lime used in that city. Among other types note the shelly limestone from the Fayum (3047) and the calcite formed in veins from Bir el Jerawi, near Helwan (5223).

Coal.—Special attention has been directed to the Coals and Lignites, in view of the importance of fuel to Egyptian industries. A large series of Coals and Lignitic Coals from Abyssinia are here displayed (No. 9137, etc.), also specimens of lignitic beds from Dongola (7781) and Ain Yesin in the Kharga Oasis (9762). The Dongola examples are being further investigated with a view to determining their extension. For Sinai Coal see Economic Gallery, p. 7.

Sandstone.—South of Esna the Sandstones are the main members of the rock series (except in the Cataract districts). and extend southward far up the White Nile, and eastward to the confines of Abyssinia.

Numerous varieties are exhibited including the compact quartzites from Baharia Oasis (1513), from Western Sinai (3884, 4308, etc.), and the quartzite resulting from the baking of the sandstone by the intrusion of dolerites (No. 6146, Jebel Sadek, Third Cataract district).

Conglomerates are frequently present, especially near the junction of the sandstone with the underlying igneous rock. Note especially No. 6175, from Jebel Kadugu, near Kosha, between Wady Halfa and Dongola.

Many of the sandstones are highly ferruginous, and some of those near Wady Halfa (No. 4638) are made up of small oolitic grains. The roçk in this case approaches bog iron ore in its composition, and was probably originally deposited in shallow lakes. Note also the very dark ferruginous sandstones from Baharia Oasis (1464 and 1522).

Some of these rocks are often brilliantly coloured and banded, these characters giving Petra, the ancient capital of Edom, its peculiar charm. An example of this nature from Eastern Sinai (No. 3459) is here exhibited.

Laterites.—In tropical latitudes the surface is covered by a series of highly argillaceous and ferruginous rocks (laterites, etc.), which are specially well developed in Uganda. Special attention may be directed to No. 7730 which in its composition approaches Kaolin (porcelain clay), and may also be of importance as a source of the metal aluminium.

Case 11 is devoted to certain features well developed in Egypt. In the division nearest the western door a series is exhibited illustrating the changes which have taken place when igneous rocks in molten condition have been in contact with sedimentary members.

The andesite or porphyrite No. 4634 has altered the sandstone to a columnar form (No. 4632) or to a compact saccharine quartzite (4633) at the Kaibar Cataract, while further south, near Kerma, north of Dongola, the columns are of such large size that only an isolated portion can be shown (No. 6148), the dolerite causing the change being also exhibited (6128). Similarly the dolerite 1509 has given rise to a ferruginous compact texture in the limestone of Baharia Oasis (1508) and similar limestones are exhibited from Gara Soda, etc.

Wind action.—Sand blown by wind across the desert has had a great effect in wearing the rocks over which it is swept.

In some cases the softer parts of a rock have been eaten away, leaving only the harder layers (No. 5187, Wadi Akhaba, West Sinai), in others the limestones have been deeply grooved and furrowed, as in the Fayum (3066) and near Qena (5128). In a conglomerate the softer cementing material may be removed from round the harder pebbles, as in (7497) from Um Qamr, in the Cairo-Suez Desert. Isolated pillars of the original rock may be left erect when the rest has been removed by sand-etching (5083, Abu Roash, near Cairo); the most delicate etching effects may be produced (5090, Abu Roash) or the "dreikanter," one of the characteristic results of wind blown sand, called into being (5086, Abu Roash).

In some cases quartz pebbles have been completely planed down (No. 5723 in the desert between the Pyramids and Fayum).

The great alternations of temperature may also produce cracking (4914, Jebel Dhellal, Sinai).

The sandstones of Egypt often show grape-like concretionary structure (1540, Baharia Oasis, and 1808, in Eastern desert north of Qosseir, etc.) They are also frequently spotted owing to the aggregation of iron and manganese oxides in certain portions (No. 9582, from Jebel Silsila, and 4641, at the Second Cataract).

Beautiful examples of cone-in-cone structure have been obtained in the clays near Edfu (9586).

River Films.—Visitors to the Aswan Cataracts will have noticed highly polished black films on the rocks near high flood level. Examples of these are here exhibited (5720, etc., on granite at Aswan, 5714, on diorite near Halfa, 9630, on sandstone near Korosko, 9819 and 10101, on limestones near Samalut and Kom Ombo). No. 10145 is an interesting case from an old reservoir in the Sudan, at Gebel Geili, halfway between the Blue Nile and Atbara.

The desert rocks are often covered with similar films (5469, on limestone in western desert between Minia and Baharia Oasis).

LIST OF MAPS AND PLANS

Published by the Survey Department, and on sale at the Offices of the Survey Department, Giza, and the Geological Museum, Cairo.

Cadastral Maps.

Cadastral maps of all villages of the following Mudirias are printed in Arabic only, showing number of Hods and Plots corresponding with the Individual holdings, as entered in the Mudiria Land Registers :

				Price per sheet. Ordinary paper. Mill.	Price per sheet. Mounted cloth. Mill.
Menufia Mudiria	scale $\frac{1}{4000}$ and $\frac{1}{2500}$	Fayûm Mudiria	scale $\frac{1}{2500}$	050	065
Gharbia "	" $\frac{1}{4000}$	Qena "	" $\frac{1}{2500}$		
Qaliubia "	" $\frac{1}{2500}$	Aswan "	" $\frac{1}{2500}$		
Daqahlia "	" $\frac{1}{2500}$	Girga "	" $\frac{1}{2500}$		
Giza "	" $\frac{1}{4000}$	Assiut "	" $\frac{1}{2500}$		

Topographical Maps.

Topographical Maps of the following Provinces, showing villages and Markaz boundaries and all water courses, published on scale $\frac{1}{10000}$.

	Ordinary paper. Mill.	Mounted cloth. Mill.
Behera Province in Arabic, published in 264 sheets	100	—
Gharbia Province in English and Arabic, 156 sheets published only		
Giza " " " 90 " " "		

Topographical maps of Qaliubia and Fayûm Provinces, scale $\frac{1}{10000}$, are about to be published.

Province Maps.

		Ordinary paper. Mill.	Mounted cloth. Mill.
Maps of provinces of Lower and Upper Egypt, printed in English or Arabic separately, scale $\frac{1}{100000}$ of 4 and 2 sheets		120	—
Girga Province (Provisional) scale $\frac{1}{25000}$ published in English and Arabic	in 18 sheets	100	—
Assiut Province " scale $\frac{1}{50000}$ " " "	in 5 sheets	100	—
Qena Province " " " " "	in 6 sheets	100	—
Aswan Province " " " "	in 4 sheets	100	—
Minia Province " " " " "	in 5 sheets	100	—
Fayûm Province " " " " "	in 10 sheets	065	—
Beni Suef Province " " " " "	in 2 sheets	100	—

Maps of Egypt.

			Ordinary paper. Mill.	Mounted cloth. Mill.
The Nile Valley from Aswan to Korosko, in English	36 sheets, scale	$\frac{1}{10000}$	075	—
The First Cataract, in English (revised)	6 "	$\frac{1}{10000}$	100	—
Kharga Oasis, in English	1 "	$\frac{1}{50000}$	100	—
Dakhla Oasis, in English	1 "	$\frac{1}{50000}$	100	—
Mersa Matruh and Ras Allam Rum	2 "	$\frac{1}{25000}$	100	—
Lower Egypt and the Fayûm, 1904.	1 "	$\frac{1}{500000}$	100	—
Map of Egypt, 1905 (in the press)	— "	$\frac{1}{50000}$	—	—

Town Maps.

			Ordinary paper. Mill.	Mounted cloth. Mill.
Cairo and Environs, in English	4 sheets, scale	$\frac{1}{10000}$	075	—
" "	16 "	$\frac{1}{4000}$	120	—
Mit-Ghamr, in English and Arabic	4 "	$\frac{1}{1000}$	100	—
Mansura, " "	16 "	$\frac{1}{1000}$	100	—
Suez, " "	20 "	$\frac{1}{1000}$	100	—
Suez, " "	1 "	$\frac{1}{2500}$	100	—
Port Said	1 "	$\frac{1}{5000}$	120	—
Girga. .. } in the press.			—	—
Sohag .. }			—	—
Tanta. .. }			—	—

LIST OF PUBLICATIONS

Title.	Price.	
	L.E.	Mill.
PUBLIC WORKS MINISTRY.		
Irrigation Reports.		
A Report upon the Basin of the Upper Nile with proposals for the improvement of that river, 1904	—	600
Irrigation Report for the year 1884	—	100
Report on the Administration of the Irrigation Department, for the years 1891, 1895, 1896 and 1897 Each	—	250
Report upon the Administration of Public Works Department, for the years 1899 and 1900 Each	—	250
Report upon the Administration of Public Works Department, for the years 1901, 1902, 1903 and 1904	—	300
Note on the Irrigation Works of Egypt and the improvements to be made to them, 1884	—	100
Report on drainage and pumping stations in Holland, 1897	—	150
The Egyptian Canal Act 1890	—	050
Note on the Nile Flood for 1887	—	120
Note on the Wadi Rayan Project, 1889	—	100
Note on the Nile Barrage, 1890	—	100
Nile Reservoir Reports, 1891	—	120
Nile Reservoirs Appendices, 1892	—	120
Perennial Irrigation and Flood protection for Egypt, 1894	—	600
Report of the Technical Commission on Reservoirs, 1894	—	300
Note on the Sudan, 1899	—	120
Note on the Prospects of the Nile Summer supply in 1900	—	100
The Delta Barrage, 1902	—	400
Report on the Irrigation of the Valley of the River Po (Northern Italy), 1902	—	400
Readings of the Aswan Gauge in pics and metres from January, 1871 to December, 1892	—	100
Report on Siwa Oasis, 1900	—	200
SURVEY DEPARTMENT.		
An Almanac for the years 1904, 1905 and 1906, English or Arabic edition	—	025
Geological Reports.		
Report on the Phosphate Deposits of Egypt, Revised 1905	—	050
Geological and Topographical Report on Kharga Oasis, 1899	—	250
„ „ „ Farafra Oasis, 1899	—	150
„ „ „ Dakhla Oasis, 1900	—	200
„ „ „ Baharia Oasis, 1903	—	200
Report on the Jebel Garra and the Oasis of Kurkur, 1902	—	150
Report of the Cretaceous Region of Abu Roash, near Cairo, 1902	—	200
Report on the Topography and Geology of the Eastern Desert, 1903	—	400
The Topography and Geology of the Fayûm Province, 1905	—	300
Note on the Arsinoitherium Zitteli from the Upper Eocene Strata of Egypt, 1902	—	050
Note on some New Fossil Mammals, 1902	—	100
A preliminary notice of a Land Tortoise from the Upper Eocene of the Fayum, 1903	—	050
A preliminary investigation of the Soil and Water of the Fayum Province, 1902	—	075
Report on the Disintegration of Building Stones in Egypt, 1902	—	075
A Report on the Soil and Water of Wadi Tumilat, 1903	—	100
The Blackened Rocks of the Nile Cataract, 1905	—	100
A Sketch Report on the Petroleum Industry at Baku, 1886	—	100
Report on the Geology and Petroleum of Ras Gemseh and Jebel-Zeit, 1887	—	200
Report on the Petroleum Districts situated on the Red Sea Coasts, 1888	—	100
Meteorological Reports.		
Annual Meteorological Report for 1898-1899, 1900, 1901, 1902, 1903 and 1904 Each	—	250
Monthly Meteorological Observations (in monthly sheets), at Port-Said, Alexandria, Abbassia (Cairo), Helwan, Giza, Assiut, Aswan, Wadi-Halfa, Suakin, Berber, Omdurman, Khartoum, Wad-Medani, Dueim, Mongalla, Roseires and Dakhla Oasis, per sheet at	—	005
The Rains of the Nile Basin in 1904 and 1905 Each	—	050
On the use of Platinum Resistance Thermometers, 1905	—	050
List of Maps, Plans and Publications, up to 31st December, 1905	Gratis.	

The Topography and Geology of Eastern Sinai .. }
„ „ Western Sinai .. }
Geology of the Country between Cairo and Suez .. } in the press.
The Physiography of the River Nile and its Basin .. }

Syracuse, N. Y.
Stockton, Calif.